JOHNSONGRASS CONTROL BY HERBICIDES APPLIED TO REGROWTH

by

GARY LEE GAMBLE

B. S., Fresno State College, 1960

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1962

TABLE OF CONTENTS

INTRODUCTION 1

LITERATURE REVIEW 2

MATERIALS AND METHODS 7

EXPERIMENTAL RESULTS 8

DISCUSSION 33

SUMMARY 35

ACKNOWLEDGMENT 36

LITERATURE CITED 37

INTRODUCTION

Johnsongrass (Sorghum halepense (L.) Pers.) has become a serious weed problem in Kansas that is second only to field bindweed (Convolvulus arvensis). Originally it was confined to the southeastern counties but has spread rapidly in the western counties where irrigation has come into use. It has been declared a noxious weed under provisions of the Kansas Weed Law.

Since its introduction, johnsongrass has become widely distributed throughout the southern states and has spread north as far as the 38th parallel. It is found from the Atlantic coast to the Colorado border. It is found in the Potomac and Ohio Valleys and in California, New Mexico, and Arizona.

Since johnsongrass is a pest in so many areas its importance as a forage and pasture crop is often overlooked. Hay made from johnsongrass, when properly cured, compares favorably with sudangrass. Johnsongrass is usually cut for hay before it blooms in order to avoid the development and dispersal of seeds.

The objectives of this study were two-fold: (1) to obtain basic information concerning the last practical dates for chemical control and (2) to determine the effects of dalapon (2,2 dichloroproponiate), garlon (Diethylene glycol bis dichloroproponiate 2,2,4,5 Trichlorophenoxy) propionic acid propylene glycol), and M-1515, a new experimental herbicide, when applied to johnsongrass regrowth following mowing at weekly intervals.

LITERATURE REVIEW

Vinall and Crosby (16) described johnsongrass as a stout perennial grass with rather broad leaves in which the middle vein is prominent by being thickened and white. The inflorescense is an open loose panicle, 6 to 24 inches long. The culms or stems are from 3 to 10 feet high, determined by the moisture content and fertility of the soil. Numerous rhizomes, which send up shoots from the nodes, are present along with the fibrous roots associated with grasses. The presence of rhizomes distinguish johnsongrass from sudangrass (Sorghum sudanense), a botanically related plant. The underground system is rather shallow as compared with deep-rooted perennials. The rhizomes are usually found within the top 6 to 8 inches of the soil, but in cultivated fields they may penetrate 18 to 24 inches beneath the soil surface.

Cates and Spillman (5) classified johnsongrass rhizomes as primary, secondary, and tertiary. Primary rhizomes are those that are alive in the ground at the beginning of the growing season in the spring. Secondary rhizomes are those that arise from the primaries, form new crowns, and produce new plants. Tertiary rhizomes are those starting later in the season from the base of the crown. These tertiary rhizomes are usually large and deeply penetrating. Rhizomes of this type may penetrate to depths of 4 feet but the majority are found from 12 to 30 inches. The primary rhizomes do not survive the second year, whereas secondary and tertiary rhizomes over winter and become primary rhizomes in the spring sending out secondary shoots to repeat the cycle.

Methods for controlling johnsongrass have received much attention. In 1917, Herd (9) recommended grazing sheep on johnsongrass that was

frequently irrigated. He concluded that over grazing was the fastest way to eradicate it. Perkins (15) found that growing alfalfa on johnsongrass infested land generally gave good control after the third year. Zahnley et. al. (18) listed four general control methods which could be used in varying situations: (1) close grazing or frequent cutting followed by late fall plowing, (2) intensive cultivation, (3) intensive cultivation in combination with growing small grain, and (4) use of chemicals for small infestations.

Martin et. al. (12) stated that mowing or pasturing depletes food reserves and causes rhizomes to develop closer to the soil surface.

In general, land should be plowed in the spring and planted to a cultivated crop or summer fallowed. Under these circumstances johnsongrass often is eradicated by 6 cultivations at two-week intervals on semi-arid land and by 10-15 cultivations in humid areas.

Anderson (2) stated that deep plowing in late fall will expose the rhizomes to low winter temperatures and reduce the stand considerably.

Fletchall (7) and Overpeck (13) reported that shallow plowing in late summer followed by a long period of hot, dry weather was effective in reducing the stand through dessication of the rhizomes.

Oyer et. al. (14) concluded that under Indiana conditions, seedling johnsongrass plants should be controlled sometime before rhizomes develop; this was found to be, before the seven-leaf stage. It apparently is not sufficient merely to cover the crowns of seedling plants with soil during cultivation as new crowns may be formed. It is possible that complete covering of very young plants can result in adequate control. Any young plant can be controlled by cultivation whether an annual or perennial.

According to Oyer, once the rhizomes have been formed, the problem of control is multiplied many times over, as each axillary bud is capable of giving rise to a new plant. If a chemical is to be useful as a systemic herbicide for johnsongrass control, it must be translocated into all of the rhizome buds and must inhibit further growth.

Excellent control of johnsongrass is given by soil sterilants such as sodium chlorate, boron, CMU, boron-chlorate mixtures, and boron-CMU mixtures. Johnsongrass is controlled by these chemicals but the land is rendered unproductive for two or more years.

Crown oiling to kill established johnsongrass plants in crops has been tested using naptha, kerosene, diesel oil, and mixtures of these. Good results are obtained by fortifying the oils with two gallons of HCA per 100 gallons of oil.

McCall et. al. (11) found that Trichloroacetic (TCA) applied at a rate of 1 pound per square rod to growing plants killed 98 percent of the stand.

One of the most effective chemicals for control of johnsongrass is dalapon, which is used as a foliage application. Investigators (1,2,3, 6,7,8,10,17,18) have found that applications of from 16 to 40 pounds of dalapon per acre gave excellent control when applied to the foliage during early growth stages.

Fletchall (7) reported that dalapon at 10 to 12 pounds per acre applied in the spring when the johnsongrass was about 10 inches tall followed by plowing about a week after spraying gave good results in limited tests. Two or three light applications at approximately one week intervals appeared to give slightly better control than a single treatment at a rate equal to the total of the split applications.

Watson (17) found dalapon to be effective for spot treatment of johnsongrass in cotton. Optimum concentration was 1/5 pound of 85 percent dalapon per gallon of water applied on the plants until thoroughly wetted. Cotton wet by the spray was generally killed but the loss was about the same as would have occurred by hoeing.

Arle et. al. (3) stated that dalapon should be applied to johnsongrass shoots when they are 6 to 10 inches high. To achieve maximum control, at least three days should elapse between dalapon application and any cultivation.

Arle et. al. (3) reported that a single application of dalapon under Arizona conditions did not suppress johnsongrass throughout the entire season. Generally, an application of dalapon stops growth for about six weeks.

Hausers et. al. (8) observations indicated that the rapid necrosis induced by higher rates is undesirable and suggested that advanced necrosis interfers with further translocation. Consequently, final control of johnsongrass with higher rates of dalapon is reduced as compared to lower repeated applications. Their greenhouse data show that dalapon is absorbed very rapidly after application but that about two weeks are required for maximum translocation to the rhizomes.

Anderson (1) found that dalapon and 2,2,3, trichloropropionate at 20 and 40 pounds per acre gave excellent control of johnsongrass in Kansas. It was found that dalapon applied at the six-week stage as a single 20-pound per-acre or in two 10-pound per-acre applications gave excellent control. Although 2,2,3 trichloropropionate gave satisfactory control at 20 pounds per acre, it was not as effective as dalapon.

In an unpublished thesis by John Weseloh it was concluded that

dalapon in combination with mowing extended for approximately 5 weeks the period during which johnsongrass could be controlled. The response of garlon to mowing differed from dalapon in that it was as effective in controlling johnsongrass on nonmowed plots as on mowed plots for the first three-week period. Following the third week, garlon was more effective for the control of johnsongrass regrowth than it was on nonmowed johnsongrass. Garlon and dalapon were equally effective for control of johnsongrass regrowth.

Arle et. al. stated that dalapon has proven successful for controlling Bermuda grass (Cynodon dactylon). This grass is more susceptible than johnsongrass to dalapon. Complete destruction of bermuda grass is often achieved with one application.

Barrons (4) found that dosages of 12 to 15 pounds of dalapon per acre gave good control of quackgrass (Agropyron repens) when applied in September, October, and November. He also found that following dalapon treatments some quackgrass recovered, although in a weakened condition. Spring plowing after fall application weakened the quackgrass and subsequent crop competition and cultivation further retarded recovery.

Klingman (10) reported that dalapon used properly will control annual grasses in sugar beets, potatoes, flax, grapes, and in apple, pear, peach, plum, and apricot orchards.

Thus dalapon provides an effective weapon with which to control annual and perennial grasses under a great variety of conditions.

MATERIALS AND METHODS

A bottom-land area heavily infested with johnsongrass near Council Grove, Kansas was leased for the purpose of studying the effects of dalapon, garlon, and M-1515 on johnsongrass regrowth following mowing at weekly intervals. Garlon is a new formulation being used for johnsongrass control and M-1515 is still in the experimental stage.

The experimental design was a split plot. Plot size was one square rod. The treatments were as follows:

Table 1. Summary of the treatments used for this experiment.

Plots	:	Treatments
Mowed		Dalapon - split application of 5 pounds per acre
		Dalapon - split application of 10 and 5 pounds per acre
		Dalapon - 15 pounds per acre
		Garlon - 4 gallons per acre
		M-1515 - 4 gallons per acre
		Dalapon - 15 pounds per acre with no wetting agent
Nonmowed		Dalapon - 15 pounds per acre
		Garlon - 4 gallons per acre

Each week for a 9-week period six plots were mowed and the top growth removed from each of the replications. The chemicals were applied to the mowed plots when the re-growth had reached a height of 18 to 24 inches. The unmowed plots were sprayed at the same time as the mowed plots in their respective block. A wetting agent was used with all chemicals except the one treatment of dalapon at 15 pounds per acre.

Evaluation of the treatments were made by counting the established plants in an area four by four feet the following June.

The rainfall total for the 9-week period of the experiment was 14.57 inches. No rainfall was received on the dates of spraying.

The chemicals were furnished by the Dow Chemical Company, Midland, Michigan.

Table 2. Dates which plots were mowed and sprayed.

Plot-Mowing Date	:	Plot-Spraying Date
7-11		8-1
7-18		8-10
7-25		8-15
8-1		8-22
8-8		8-31
8-15		9-12
8-22		9-12
8-29		9-19
9-5		9-19

EXPERIMENTAL RESULTS

To simplify the graphs in this paper a key was made for the chemicals, it is given in Table 3. This key will be used throughout the paper.

Table 4 gives the observed means of the established johnsongrass plants in the mowed and unmowed plots for the 9-week period. The results are based upon the average of mature plants in each of the three replications.

Table 3. Key to the chemicals used in this experiment.

Chemical	Treatments
1	Dalapon - split application of 5 lbs./A each
2	Dalapon - split application of 10 and 5 lbs.
3	Dalapon - 15 lbs./A
4	Garlon - 4 gals./A
5	M-1515 - 4 gals./A
6	Dalapon - 15 lbs./A with no wetting agent
7	Dalapon - 15 lbs./A on unmowed plots
8	Garlon - 4 gals./A on unmowed plots

Table 4. Observed means of the johnsongrass plots.

Dates	Chemicals							
	1	2	3	4	5	6	7	8
7-11	0	0	2.3	1.0	0	0	7.0	3.5
7-18	.3	0	0	.67	0	1.3	5.0	2.6
7-25	.3	0	1.0	1.0	4.6	.3	14.3	19.0
8-1	1.0	.67	0	0	0	0	5.3	7.3
8-8	1.3	2.0	1.6	1.3	1.3	7.0	3.3	21.3
8-15	.67	6.7	5.3	10.0	5.0	25.6	46.0	41.6
8-22	5.0	8.3	11.0	18.3	23.3	13.3	42.3	29.6
8-29	8.0	9.6	12.0	5.6	17.0	6.7	63.3	55.0
9-5	15.3	10.6	7.3	13.3	6.0	10.0	30.0	36.6

The information in Table 5 indicates that the effects of the dalapon, garlon, and M-1515 are dependent upon the chemicals and the dates of application. The analyses were performed using the data transformed by square root of X+1 to equalize the variance between treatments and dates.

EXPLANATION OF PLATE I

General view of johnsongrass plots before treatment.

PLATE I

EXPLANATION OF PLATE II

Close up view of johnsongrass plots before treatment.

PLATE II

EXPLANATION OF PLATE III

Johnsongrass plots showing the mowed and nonmowed areas.

PLATE III

EXPLANATION OF PLATE IV

General view of the johnsongrass after treatment.

PLATE IV

EXPLANATION OF PLATE V

Close up of the johnsongrass plots after treatment.

PLATE V

EXPLANATION OF PLATE VI

General view of the area one year after treatment.

PLATE VI

Table 5. Analysis of variance showing the interaction of replications, dates, and chemical effect.

Source	d.f.	Sum of Squares	Mean Square	F
Dates	8	265.395191	33.174399	4.20**
Replications	2	34.907603	17.453802	2.21ns
Dates x Reps	16	126.307957	7.894247	8.68***
Chemicals	7	224.132367	32.018910	35.19***
Chemical x Date	56	92.475002	1.651339	1.82***
Error	126	114.638039	.909826	

** p.01
*** p.001

In Tables 6, 7, 8, 9, 10, 11, 12, 13, and 14 Fisher's LSD was used to test for significant differences among the means of the established plants. No significant differences were found among those treatments or dates which are included above the same line. All treatments not included above the same line are significantly different from each other.

The results of the dates of mowing and treatments are given in Table 15. The results are expressed as the average number of established plants recovered from an area 4x4 feet transformed in the terms of square root X+1. None of the chemicals or dates of mowing on the mowed johnsongrass plots were significantly different until after August 8. This means that treatment with any of the first six chemicals can be used on any date up to the mowing date of August 8 and there will be no significant difference in the control.

There was no significant difference between the dalapon applied on the unmowed plots and any of the chemicals applied on the mowed plots up to the mowing date of August 8. Although this is statistically true

Table 6. Ranked means of established plants for dates of mowing for the split application of dalapon.

Dalapon 5 lbs. plus 5 lbs.									
Dates of mowing	7-11	7-18	7-25	8-15	8-1	8-8	8-22	8-29	9-5
Ranked Means.	1.000	1.138	1.138	1.276	1.333	1.412	2.202	2.721	3.844

Dalapon 10 lbs. plus 5 lbs.									
Dates of mowing	7-11	7-18	7-25	8-1	8-8	8-15	8-22	9-5	8-29
Ranked Means.	1.000	1.000	1.000	1.244	1.715	2.523	2.783	3.231	3.281

Table 7. Ranked means of established plants for the mowing dates of the dalapon at 15 pounds per acre and the garlon at 4 gallons per acre.

Dalapon 15 lbs.

Dates of mowing.	7-18	7-25	8-1	8-8	7-11	8-15	9-5	8-22	8-29
Ranked Means.	1.000	1.333	1.333	1.577	1.687	2.304	2.750	3.115	3.405

Garlon 4 gals.

Dates of mowing.	8-1	7-18	7-25	7-11	8-8	8-29	8-15	9-5	8-22
Ranked Means.	1.000	1.244	1.333	1.382	1.488	2.370	3.000	3.516	3.881

Table 8. Ranked means of established plants for the mowing dates of the M-1515 at 4 gallons per acre and the dalapon at 15 pounds per acre without a wetting agent.

M-1515 4 gals.

Dates of mowing.	7-11	7-18	8-1	8-8	7-25	8-15	9-5	8-29	8-22
Ranked Means.	1.000	1.000	1.000	1.412	2.215	2.255	2.589	4.401	4.439

Dalapon 15 lbs. with no wetting agent

Dates of mowing	7-18	8-8	8-1	7-11	7-25	8-15	8-29	9-5	8-22
Ranked Means.	1.000	1.000	1.138	1.382	1.412	2.594	2.703	3.179	4.519

Table 9. Ranked means of established plants for the mowing dates of the dalapon at 15 pounds per acre and the garlon at 4 gallons per acre on the nonmowed plots.

Dalapon 15 lbs.

Dates of mowing.	8-8	7-11	7-18	8-1	7-25	9-5	8-22	8-15	8-29
Ranked Means.	2.060	2.219	2.276	2.304	2.714	5.154	6.091	6.597	7.963

Garlon 4 gals.

Dates of mowing.	7-18	8-1	7-11	7-25	8-8	8-22	9-5	8-15	8-29
Ranked Means.	1.793	2.879	3.144	4.280	4.369	5.263	5.526	5.970	7.198

Table 10. Ranked means of established plants for the treatments on July 11 and July 18.

July 11

Treatments	1	2	5	4	6	3	7	8
Ranked Means.	1.000	1.000	1.000	1.382	1.382	1.687	2.219	3.144

July 18

Treatments	2	3	5	6	1	4	8	7
Ranked Means.	1.000	1.000	1.000	1.000	1.138	1.244	1.793	2.276

Table 11. Ranked means of established plants for the treatments on July 25 and August 1.

July 25

Treatments	2	1	3	4	6	5	7	8
Ranked Means.	1.000	1.138	1.333	1.333	1.412	2.215	2.714	4.280

August 1

Treatments	4	5	6	2	1	3	7	8
Ranked Means.	1.000	1.000	1.138	1.244	1.333	1.333	2.304	2.879

Table 12. Ranked means of established plants for the treatments on August 8 and August 15.

August 8

Treatments	6	1	5	4	3	2	7	8
Ranked Means.	1.000	1.412	1.412	1.488	1.577	1.715	2.060	4.369

August 15

Treatments	1	5	3	2	6	4	8	7
Ranked Means.	1.276	2.255	2.304	2.523	2.594	3.000	5.970	6.597

Table 13. Ranked means of established plants for the treatments on August 22 and August 29.

August 22

Treatments	1	2	3	4	5	6	8	7
Ranked Means.	2.202	2.783	3.115	3.881	4.439	4.519	5.263	6.091

August 29

Treatments	4	6	1	2	3	5	8	7
Ranked Means.	2.370	2.703	2.721	3.281	3.405	4.041	7.198	7.963

Table 14. Ranked means of established plants for the treatments on September 5.

September 5								
Treatments	5	3	6	2	4	1	7	8
Ranked Means.	2.589	2.750	3.179	3.231	3.516	3.844	5.154	5.526

a look at the mean stand count (Table 4) shows us that this would not be economical for the farmer.

The last effective date of mowing for the split application of dalapon at 5 pounds per acre for each application was August 22. The treatment will not be significantly different for any mowing date until after August 22. For the split application of dalapon at 10 pounds per acre plus 5 pounds per acre the last effective date of mowing was August 15. This date August 15 also holds true for the dalapon at 15 pounds per acre and the M-1515 at 4 gallons per acre. August 8 was the last effective date for mowing the plots treated with dalapon at 15 pounds per acre with no wetting agent and the 4 gallons of garlon per acre. The unmowed plots had no significant difference until August 8 with the exception of the garlon at 4 gallons per acre on July 18.

Table 15. Means of Dates X Chemicals in terms of the square root X+1.

Date of Mowing	Chemicals							
	1	2	3	4	5	6	7	8
July 11	1.000	1.000	1.687	1.382	1.000	1.382	2.219	3.144
July 18	1.138	1.000	1.000	1.244	1.000	1.000	2.276	1.793
July 25	1.138	1.000	1.333	1.333	2.215	1.412	2.514	4.280
Aug. 1	1.333	1.244	1.333	1.000	1.000	1.138	2.304	2.879
Aug. 8	1.412	1.715	1.577	1.488	1.412	1.000	2.060	4.369
Aug. 15	1.276	2.523	2.304	3.000	2.255	2.594	6.597	5.970
Aug. 22	2.202	2.783	3.115	3.881	4.439	4.519	6.091	5.263
Aug. 29	2.721	3.281	3.405	2.370	4.041	2.703	7.963	7.198
Sept. 5	3.844	3.231	2.750	3.516	2.589	3.179	5.154	5.526

$LSD_{.05}$ 1.54

The data in Table 16 compare the results of dalapon applied on johnsongrass regrowth and dalapon applied on nonmowed johnsongrass with

control for the 9-week period. Dalapon applied to johnsongrass regrowth significantly reduced the number of established plants for the dates of mowing only After August 8.

Table 16 also compares the results between garlon applied to johnsongrass regrowth and garlon applied on nonmowed johnsongrass for the 9-week period. Garlon applied to johnsongrass regrowth significantly reduced the number of established plants for all dates studied with the exception of July 18.

Table 16. Comparison of dalapon and garlon applied to johnsongrass regrowth and nonmowed johnsongrass for the 9-week period.

	Mean of established plants					
Dates	Dalapon mowed		Dalapon not mowed	Garlon mowed		Garlon not mowed
July 11	1.687	ns	2.219	1.382	*	3.144
July 18	1.000	ns	2.276	1.244	ns	1.793
July 25	1.333	ns	2.514	1.333	*	4.280
Aug. 1	1.333	ns	2.304	1.000	*	2.879
Aug. 8	1.577	ns	2.060	1.488	*	4.369
Aug. 15	2.304	*	6.597	3.000	*	5.970
Aug. 22	3.115	*	6.091	3.881	*	5.263
Aug. 29	3.405	*	7.963	2.320	*	7.198
Sept. 5	2.750	*	5.154	3.516	*	5.520

* least significant range .05 1.54
ns nonsignificant

DISCUSSION

The effectiveness of the control was found to be dependent upon the date of mowing and the treatment. It appears that any of the treatments used on the mowed plots and the dalapon applied to the

nonmowed johnsongrass were not significantly different until after the mowing date of August 8.

The last effective date of mowing for the split application of dalapon at 5 pounds per acre for each application was August 22. The treatment was not significantly different for any mowing date until after August 22. For the split application of dalapon at 10 pounds per acre plus 5 pounds the last effective date of mowing was August 15. This date, August 15, also holds true for the dalapon at 15 pounds per acre and the 4 gallons of M-1515 per acre. August 8 was the last effective date for mowing the plots treated with dalapon at 15 pounds per acre with no wetting agent and the 4 gallons of garlon per acre. The unmowed plots had no significant difference until August 8 with the exception of garlon at 4 gallons per acre on July 18.

Dalapon applied to johnsongrass regrowth significantly reduced the number of established plants for the dates of mowing only after August 8. Up to August 8 there was not any significant difference between the treatment applied to the johnsongrass regrowth or to the nonmowed plots. Although this is statistically true, a look at the mean stand count (Table 4) shows us that the treatment applied on the nonmowed johnsongrass would not be practical for the farmers.

Garlon applied to johnsongrass regrowth significantly reduced the number of established plants for all dates included with the exception of July 18. No reason can be given for this exception.

Under conditions of this experiment it was found that a wetting agent did not increase the effectiveness of the treatments until after August 8. After August 8 the addition of a wetting agent extended the length of the control period.

SUMMARY

Based on experimental results, it was found that:

1. None of the treatments, with the exception of garlon on the nonmowed plots, were significantly different until after August 8.

2. Dalapon can be applied to mowed and nonmowed johnsongrass equally effective up to the mowing date of August 8. This is statistically correct but Table 4 shows us that it would not be economical for a farmer to spray nonmowed johnsongrass.

3. Garlon applied to johnsongrass regrowth significantly reduced the number of established plants for all dates studied except July 18.

4. A wetting agent was not necessary until after the mowing date of August 8. After this date a wetting agent increases the length of the control period.

ACKNOWLEDGMENT

The author expresses his sincere appreciation to Dr. L. E. Anderson for his suggesting the problem, for his guidance throughout this investigation, and for critical reading and correction of the manuscript.

Sincere appreciation is expressed to Mr. Leslie Marcus for assistance in statistical analysis of the data.

Special thanks are extended to the Dow Chemical Company for providing materials used in this study.

LITERATURE CITED

(1) Anderson, L. E.
Chemical control of johnsongrass. Proc. Thirteenth Annual North Central Weed Cont. Conf. p. 32. 1956.

(2) Anderson, L. E.
Johnsongrass in Kansas. Kansas Agr. Exp. Sta. Cir. 380. Feb., 1961.

(3) Arle, H. F., and K. C. Hamilton.
Johnsongrass control with dalapon and liquified petroleum burners. Arizona Agr. Exp. Sta. Bul. 293. April, 1959.

(4) Barrons, Keith C.
Fall application of dalapon for quackgrass control. Down to Earth. vol. 12, no. 4. Spring, 1957.

(5) Cates, J. S., and W. J. Spillman.
A method of eradication for johnsongrass. U. S. Dept. Agr. Farmers Bul. 279. 1907.

(6) Fletchall, O. H., J. W. Murphy, and J. R. Fleetwood.
You can control johnsongrass. Univ. of Missouri Agr. Exp. Sta. Bul. 729. 1959.

(7) Fletchall, O. H.
Control of herbaceous perennial weeds. Proc. Fifteenth Annual North Central Weed Cont. Conf. p. 49. 1958.

(8) Hauser, E. W., and J. T. Thompson.
A study of the absorption and translocation of several chemicals in johnsongrass, and an evaluation of their effectiveness for its control under field conditions. Weeds, vol. 7. 1959.

(9) Herd, H. C.
Johnsongrass control. Arizona Agr. Exp. Sta. Bul. 82. 1917.

(10) Klingman, Glenn C.
Weed Control: as a science. New York - London: John Wiley & Sons, Inc. 1961.

(11) McCall, G. L., and J. W. Zahnley.
Control of noxious perennial grasses with the trichloracetates. Kansas Agr. Exp. Sta. Cir. 255. January, 1949.

(12) Martin, J. H., and W. H. Leonard.
Principles of field crop production. New York: The Macmillan. 1949.

(13) Overpeck, J. C.
Johnsongrass eradication. New Mexico Agr. Exp. Sta. Bul. 146. 1925.

(14) Oyer, E. B., G. H. Gries, and B. J. Rogers.
The seasonal development of johnsongrass plants. Weeds. vol. 7. 1959.

(15) Perkins, W. R.
Johnsongrass. Louisiana Agr. Ex. Cir. 10. 1916.

(16) Vinall, H. W., and M. A. Crosby.
The production of johnsongrass for hay and pasturage. U. S. Dept. Agr. Farmer's Bul. 1597. 1929.

(17) Watson, A. J.
Johnsongrass control with dalapon in the Mississippi Delta. Down to Earth. vol. 12, no. 3. Winter, 1956.

(18) Zahnley, J. W., L. E. Anderson, and O. G. Russ.
Controlling weeds in Kansas. Kansas Agr. Exp. Sta. Bul. 390. 1957.

JOHNSONGRASS CONTROL BY HERBICIDES APPLIED TO REGROWTH

by

GARY LEE GAMBLE

B. S., Fresno State College, 1960

AN ABSTRACT OF A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agronomy

KANSAS STATE UNIVERSITY

Manhattan, Kansas

1962

Johnsongrass (Sorghum halepense (L.) Pers.) has become a serious weed problem in Kansas that is second only to field bindweed (Convolvulus arvensis). It has been declared a noxious weed under provisions of the Kansas Weed Law. The objectives of this study were two-fold: (1) to obtain basic information concerning the last practical date for chemical control and (2) to determine the effects of dalapon (2,2 dichloropropoaniate), garlon (diethylene glycol bis dichloropropionate plus 2, (2,4,5 trichlorophenoxy) propionic acid propyline glycol), and M-1515, a new experimental herbicide, applied to johnsongrass regrowth following mowing at weekly intervals and to unmowed johnsongrass.

The following treatments were used on the mowed and unmowed plots when the regrowth had reached a height of 18 to 24 inches.

Control - neither sprayed nor mowed.

Mowed - (1) regrowth sprayed with dalapon at 5 pounds per acre for each application.

(2) regrowth sprayed with dalapon at 10 pounds per acre and followed with a 5 pound application in two weeks.

(3) regrowth sprayed with dalapon at 15 pounds per acre.

Original growth - sprayed with dalapon at 15 pounds per acre.

Mowed - (1) regrowth sprayed with garlon at 4 gallons per acre.

(2) regrowth sprayed with M-1515 at 4 gallons per acre.

(3) regrowth sprayed with dalapon at 15 pounds per acre but with no wetting agent.

Original growth - sprayed with garlon at 4 gallons per acre.

It was found that the effectiveness of control was dependent upon the date of mowing and the treatment. None of the treatments, with the

exception of garlon on the nonmowed plots, were significantly different until after August 8. Dalapon applied to johnsongrass regrowth significantly reduced the number of established plants only after the mowing date of August 8. The garlon applied to nonmowed johnsongrass significantly reduced the number of established plants for all dates studied except July 18.

It was found that a wetting agent had no significant effect until after the mowing date of August 8. Use of a wetting agent after this date extended the period for effective control.